D 99007 PCT

SURFACTANT COMPOSITION CONTAINING GEMINI SURFACTANTS AND ITS USE FOR SKIN AND HAIR CLEANING PREPARATIONS

This invention relates to a surfactant composition containing one or more gemini surfactant(s) and at least one different detergent component with mild, poor initial foaming characteristics, and to the use of such composition as a multifunctional cosmetic preparation for cleaning and treating the skin and hair.

In order to largely avoid skin injuries caused by daily cleaning of the skin and hair, it is essential to employ non-irritating, mild detergents. It is known, however, that the foaming power of a surfactant used as one of the basic constituents of a detergent decreases considerably as its mildness increases so that satisfactory initial foaming of such surfactants on the skin and hair with large spreading of the foam and the desirable absorption of dirt cannot be guaranteed. If such surfactants are nevertheless employed in detergents, it is frequently necessary to combine them with far less mild surfactants.

Recently, gemini surfactants have been examined and found to be exceptionally mild to the skin. Owing to their poor foaming power, however, they have not been widely used in cleaning preparations. For a comprehensive survey of the state of the art regarding gemini surfactants, see R. Zana 'Bolaform and dimeric (gemini) surfactants', *Novel Surfactants: Preparation, Application and Biodegradability*, C. Holmberg (ed.), Marcel Dekker, (1998), 81,103.

EP-A-0 697 244 discloses amphoteric gemini surfactants, which can also be mixed with other anionic, nonionic, cationic, or amphoteric surfactants. Said surfactants are reported to be useful in detergents.

The gemini surfactants (gemini amides) described in WO 95/19953 can be employed among others as components in customary cleaning preparations. In WO 95/19955 gemini polyethers have been disclosed as another class of gemini surfactants, which are useful for the same application mentioned hereinbefore. Mixtures of alkoxylated bisalkylphenol gemini surfactants and other surfactants are known from WO 97/23449.

In JP-A 11/60430 and JP-A 11/60437 the use of anionic gemini surfactants in cosmetics has been described. Reportedly, these surfactants can also be combined with other surfactants.

It is an object of the present invention to provide surfactant blends, which will allow to preserve the dermatological advantages of gemini surfactants while simultaneously enhancing their foaming power and to increase thus the cleaning power of the surfactant compositions to an extent which will make them superior to conventional skin and hair cleaning preparations.

According to the present invention, the problem has been solved by providing a surfactant composition containing besides other constituents the following components:

(A) 1 to 90 wt%, preferably 10 to 80 wt%, 20 to 60 wt%, or even 30 to 50 wt%, each referring to the total quantity of components (A) and (B), of one or more gemini surfactant(s) and,

(B) referring to the remainder, 99 to 10 wt%, or 90 to 20 wt%, 80 to 40 wt%, or 70 to 50 wt%, each based on the total quantity of components (A) and (B), of at least one additional different detergent component having mild, poor initial foaming characteristics.

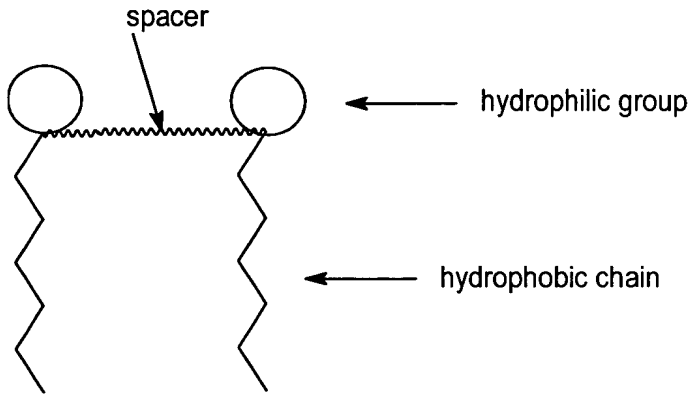
The preferred embodiments of the subject invention are set out in the subordinate claims.

It has unexpectedly been found that the surfactant composition of the invention yields an exceptionally creamy and fine-bead wet foam with very good initial foaming features, which is desirable for skin and hair cleaning preparations. Moreover, such surfactant blends when applied to the hair are superior by the significantly improved combability of wet/dry hair due to the high affinity of the gemini surfactants and the good antistatic features. When utilized in skin cleaners, the preparations have been found to make the skin silky and to allow satisfactory regreasing of the skin. The blends of the present invention are outstanding by their considerably improved non-irritating characterisitcs in comparison with customary anionic surfactants. For example, by addition of the surfactant compositions of the invention to alkylether sulfates, alkyl benzene sulfonates, and other anionic surfactants, the irritating effect can be distinctly reduced.

For the purpose of the present invention the term 'gemini surfactant' is defined as a surface-active compound consisting of at least (preferably) two surfactant units, i.e. one hydrophilic head group and one hydrophobic group interlinked through at least (preferably) one spacer in proximity to the head group. Gemini surfactants are also

termed dimer surfactants because of their specific structure. There exist anionic, nonionic, cationic, and amphoteric gemini surfactants, depending on the kind of head group. The subject matter of the present invention relates to anionic, cationic, and neutral gemini surfactants. However, in contrast to conventional surfactants, which are grouped in the same way, gemini surfactants can also have combinations of different head groups, mostly combinations of nonionic and ionic groups.

Whenever ionic head groups are combined with nonionic ones, the ionic head group shall be predominant in the resultant gemini surfactant, such that combinations of a nonionic head group and an anionic head group can be classified as anionic gemini surfactant. The same applies to combinations of nonionic head groups with cationic or amphoteric ones. As to the surfactant compositions of the invention, it is morphology (i.e. the relative arrangement of different structural units, namely, hydrophilic groups, spacer, hydrophobic chains) that is essential, the type of head group is not. Hence, the gemini surfactants of the present invention have the following structure:

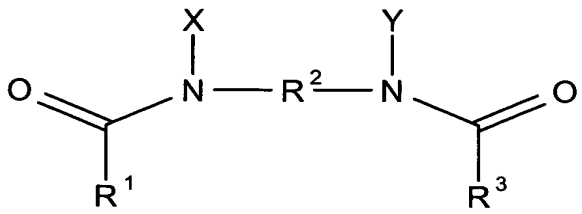


The preferred gemini surfactants used in the surfactant compositions of the invention have nitrogen atoms at the link between spacer, hydrophilic group, and hydrophobic group. More preferably, the gemini surfactants have spacers with amine or amide groups, but also spacers derived from dicarboxylic acids, betaine-derived hydrophilic double head groups, optionally presenting side groups obtained by alkoxylation, especially ethoxylation, which head groups may bear sulfonic acid-, phosphonic acid-, carboxylic acid-, or alcohol groups, including polyalcohols, each of which having hydrophobic chains with 5 to 25 carbon atoms, which are branched or unbranched and may bear up to two non-adjacent double bonds.

The following variants of gemini surfactant structures are particularly useful for the surfactant compositions of the invention.

Variant A: Structures based on amide- or amine-containing spacers

A.I Gemini surfactants of the general formula (A.I) according to WO 96/14926

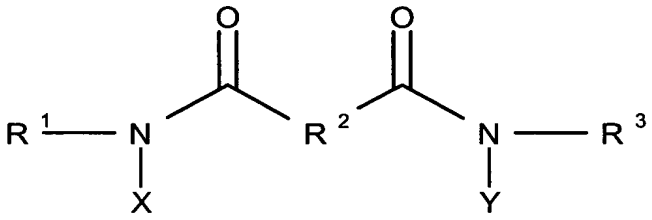


(A.I),

wherein the substituents have the following meanings:

R^1, R^3	C_5- to C_{25}-alkyl, branched or unbranched, saturated, optionally as far as non-adjacently diunsaturated;
R^2	C_1- to C_{12}-alkylene;
X, Y	$(C_2H_4O\text{-})_x(C_3H_6O\text{-})_y\text{-FR}$; $x+y \geq 1$, x: 0-15, y: 0-10 ; and
FR	$-SO_3M$, $-CH_2\text{-}CO_2M$, $-P(O)(OM)_2$, H, $-C_3H_6SO_3M$; or $-CH_2(CHOH)_4CH_2OH$, insofar as x+y=0, wherein M = alkali, (alkyl) ammonium, alkanol ammonium, H, or ½ alkaline earth.

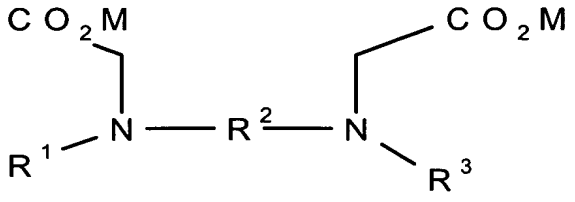
A.II Gemini surfactants having dicarboxylic acid-based spacers of the general formula (A.II) in accordance with WO 96/25388



(A.II),

wherein the substituents have the meanings as defined hereinabove by the general formula (A.I).

A.III Amphoteric gemini surfactants of the general formula (A.III) in accordance with WO 97/31890

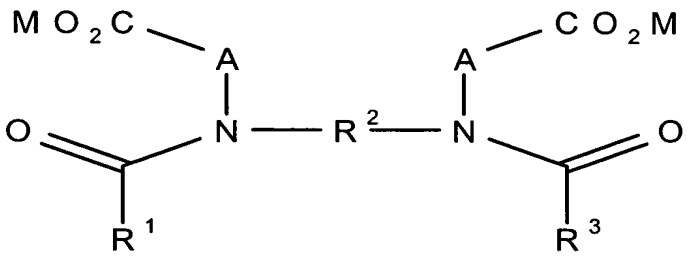


(A.III),

wherein the substituents have the meanings as defined hereinabove by the general formula (A.I). Gemini surfactants of the general formula (A.III) are amphoteric compounds, which can turn into cationic ones if the ambient medium is acidic.

Variant B: Structures based on amide- or amine-containing spacers

B.I Gemini surfactants of the general formula (B.I) in accordance with DE 19622612 or JP-A 10-175934

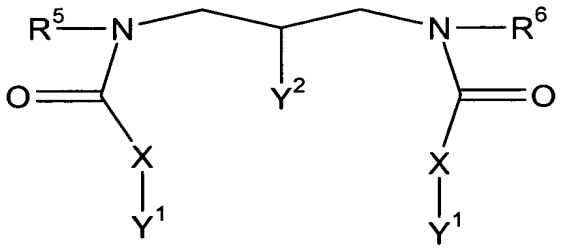


(B.I),

wherein the substituents have the following meanings:

R^1, R^3	C_5- to C_{25}-alkyl, branched or unbranched, saturated, optionally as far as non-adjacently diunsaturated;
R^2	C_1- to C_{12}-alkylene;
A	CHR^4, CH_2, C_2H_4, C_3H_6, C_4H_8;
R^4	aminocarboxylic acid radical; and
M	alkali, (alkyl) ammonium, alkanol ammonium, H, or ½ alkaline earth.

B.II Gemini surfactants of the general formula (B.II) in accordance with EP 0 708 079



(B.II),

wherein the substituents have the meanings as defined hereinabove by the general formula (B.I) and

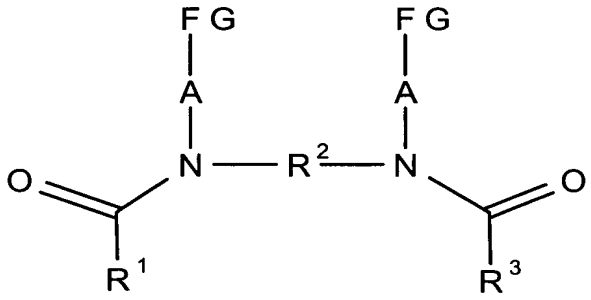
R^5, R^6 represent C_6- to C_{36}-alkyl, branched or unbranched, saturated, optionally as far as non-adjacently diunsaturated;

X is an alkylene- or alkenylene group having from 1 to 6 carbon atoms, which may be substituted with a hydroxyl group or a sulfonic acid group or a carboxy group;

Y^1 is a sulfonate- or sulfate group or a carboxyl group, and

Y^2 represents a hydroxyl group, a sulfuric acid residue, or –O-(CO)X-COOH.

B.III Gemini surfactants of the general formula (B.III) according to JP-A-8-311003

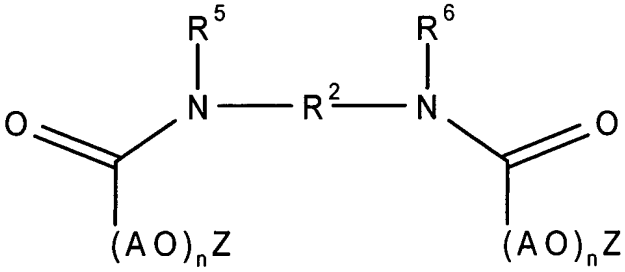


(B.III),

wherein the substituents have the meanings as defined hereinabove by the general formula (B.I) and

FG represents -COOM or $-SO_3M$.

B.IV Gemini surfactants of the general formula (B.IV) according to JP-A 11-60437



(B.IV),

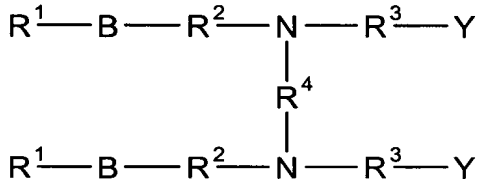
wherein the substituents have the meanings as defined hereinabove by the general formulas (B.I) and (B.II) and

AO represents alkylene oxide units, i.e. ethyleneglycol-, propyleneglycol-, and butyleneglycol ether units, alone or arranged randomly or blockwise, wherein n = 1 to 20, and

Z is $-SO_3M$, $-C_2H_4SO_3M$, $-C_3H_6SO_3M$, $-P(O)(OM)_2$ or $-CH_2-COOM$, $-C_2H_4-COOM$.

Variant C: Structures based on amide- or amine-containing spacers

C.I Gemini surfactants of the general formula (C.I) according to EP 0 697 244,



(C.I)

wherein the substituents have the following meanings:

R^1 C_5- to C_{25}-alkyl, branched or unbranched, saturated, optionally as far as non-adjacently diunsaturated, hydroxy-substituted or perfluorinated;

R^2 C_1- to C_{12}-alkylene or hydroxy-substituted derivatives thereof;

B an amide group [$-C(O)N(R^2)-$ or $-N(R^5)C(O)-$], a carboxyl group [$-C(O)O-$ or $-OC(O)-$], a polyether group [$-O(R^6-O)_x-$];

R^5 C_1- to C_4-alkyl or hydroxy-substituted alkyl or H;

R^6 C_2- to C_4-alkylene;

x a number from 1 to 20;

R^3 C_1- to C_{12}-alkyl or hydroxy-substituted derivatives thereof, R^7-D-R^7 or a poly-ether group [$-O(R^6-O)_x-$];

R^7 C_1- to C_6- alkylene or hydroxy-substituted derivatives thereof;

D -O-, -S-, $-N(R^8)-$;

R^4 alkylene or alkylaryl having from 1 to 12 carbon atoms or the hydroxy-substituted derivatives or $R^9-D^1-R^9$;

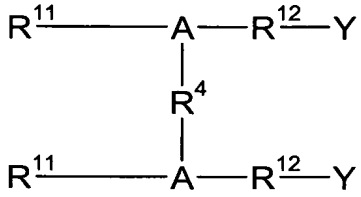
R^8 C_1- to C_{12}-alkyl or hydroxy-substituted alkyl or H or $R^9-D^1-R^9$;

R^9 C_1- to C_6-alkylene or hydroxy-substituted derivatives thereof or aryl;

D^1 -O-, -S-, $-SO_2-$, -C(O)-, $[-O(R^7-O)_x-]$, $(R^{10})_t[N(R^{10})]_z$ or aryl;

R^{10}	C_1- to C_{12}-alkyl or hydroxy-substituted alkyl or H or aryl;
t, z	are independently a number from 1 to 4, and
Y	is independently $-SO_3H$, $O-SO_3H$, $-OP(O)(OH)_2$, $-P(O)(OH)_2$, $-COOH$, $-CO_2-C_6H_4-SO_3H$ and the salts thereof.

C.II Gemini surfactants of the general formula (C.II) according to EP 0 697 245

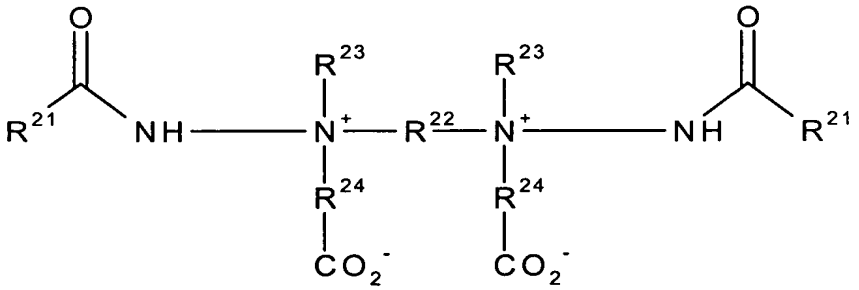


(C.II),

wherein the substituents have the meanings as defined hereinabove by the general formula (C.I) and

R^{11}	is C_5- to C_{23}-alkyl, branched or unbranched, saturated, optionally as far as non-adjacently diunsaturated, hydroxy-substituted or perfluorinated or R^{14}-B-R^2;
R^{14}	is C_1- to C_{12}-alkyl, branched or unbranched, saturated, optionally as far as non-adjacently diunsaturated, or the hydroxy-substituted derivatives;
R^{12}	means C_1- to C_{12}-alkylene, branched or unbranched, saturated, optionally as far as non-adjacently diunsaturated, or the hydroxy-substituted derivatives, or an amide group [-$C(O)N(R^2)$- or $-N(R^5)C(O)$-], a carboxyl group [-C(O)O- or -OC(O)-], a polyether group [$-O(R^6-O)_x$-] or R^9-D^1-R^9 and
A	is $-CR^6=$ or $-N=$, if whenever A is equal to $-N=$, R^{11} represents R^{14}-B-R^2.

C.III Gemini surfactants of the general formula (C.III) according to DE 4227391 and DE 19608117



(C.III),

wherein the substituents have the meanings as defined hereinabove by the general formulas (C.I) and (C.II) and

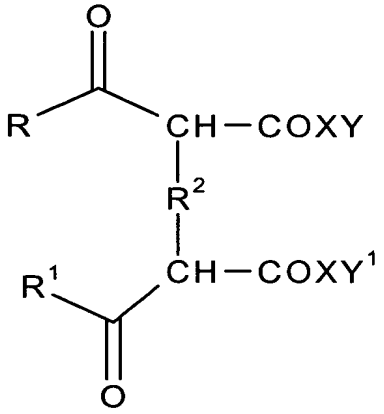
R^{21} represents C_5- to C_{23}-alkyl, branched or unbranched, saturated, optionally as far as non-adjacently diunsaturated;

R^{22}, R^{24} are C_1- to C_6-alkylene;

R^{23} is methyl, ethyl, propyl, or a polyether group $[-O(R^6\text{-}O)_x\text{-}]$.

Variant D:

D. I Gemini surfactants of the general formula (D.I) according to US 5,863,886



(D.I),

wherein the substituents have the following meanings:

R, R^1 C_5- to C_{30}-alkyl, branched or unbranched, saturated, optionally as far as non-adjacently diunsaturated, hydroxy-substituted or perfluorinated;

R^2 C_1- to C_{10}-alkylene, arylene, and hydroxy-substituted derivatives, a polyether $[-O(R^4O)_x\text{-}]$, -S-, $-SO_2$-, -O-, -S-S-, $-O\text{-}R^5\text{-}O$-, or $-S\text{-}R^5\text{-}S$-; variable for a direct bond between the two α-carbons;

R^4 C_2- to C_4-alkylene;

R^5 C_1- to C_{10}-alkylene, arylene or alkyl arylene, $-N(R^6)$-, or $-(NR^6)\text{-}R^7\text{-}(NR^6)$- ;

R^6 C_1- to C_6-alkyl;

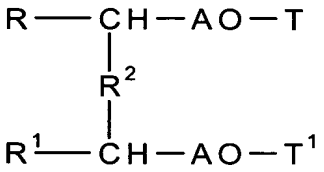
R^7 C_1- to C_6-alkyl, wherein R^7 and R^6 can also be part of a heterocyclic ring;

X polyether [-O(R^4O)$_x$-], wherein x is a number from 1 to 30, -O-, NZ;

Z C_1- to C_{10}-alkyl, aryl, alkylaryl, or H, and

Y, Y^1 are independently H, -CH_2-COOH and salts, a hydrocarbon radical having at least two hydroxyl groups, such as erythrose, threose, ribose, arabinose, xylose, fruc-tose, lyxose, allose, altrose, glucose, mannose, galactose and mixtures thereof.

D.II Gemini surfactants of the general formula (D.II)



(D.II),

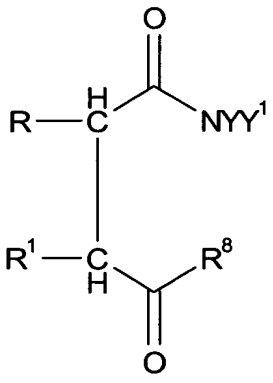
wherein the substituents have the meanings as defined hereinabove by the general formula (D.I) and

AO means -C(O)-, -C(O)- [-O(R^4O)$_x$-], -CH_2-[-O(R^4O)$_x$-], -CH_2-O-;

T, T^1 are independently -OM, -H, -CH_3, -C_2H_5, -SO_3M, -CH_2COOM, -C_2H_4-COOM, -C_3H_6-SO_3M, -O-P(O)$(OM)_2$ and

M is alkyli, ½ alkaline earth, ammonium, mono-, di-, trialkanolammonium, or H.

D.III Gemini surfactants of the general formula (D.III) according to WO 96/16930

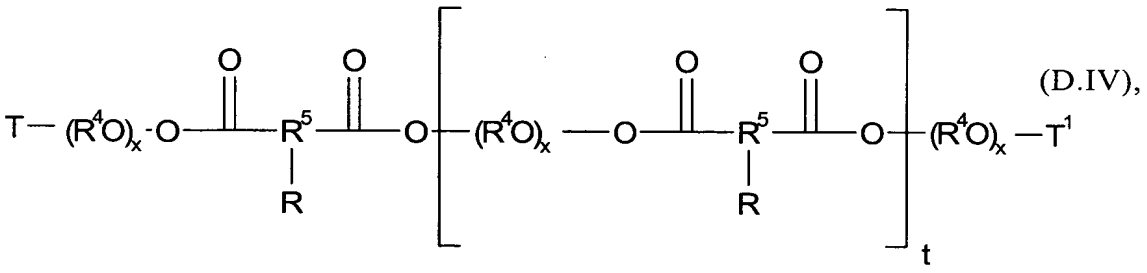


(D.III),

wherein the substituents have the meanings as defined hereinabove by the general formulas (D.I) and (D.II) and

R^8 is NYY^1, $-O(R^4O)_xH$ or $-O(R^4O)_x-C(O)-CHR-CHR^1-C(O)NYY^1$.

D.IV Gemini surfactants of the general formula (D.IV) according to WO 96/25384



(D.IV),

wherein the substituents have the meanings as defined hereinabove by the general formulas (D.I), (D.II), and (D.III) and

t is an integer from 1 to 100, preferably 1 to 20, most preferably 1 to 4.

Among the detergents with mild, poor-foaming characteristics, the compounds defined hereinbelow are preferably employed in the surfactant compositions:

Water-soluble sugar surfactants, acylated protein derivatives, sulfosuccinates, particularly sodium-, -mono-, and -dialkanolsulfosuccinates with branched or unbranched, saturated or non-adjacently mono- to triunsaturated alkyl residues in the range of from C_6 to C_{18}, or acyllactylates, particularly sodium-, potassium-, magnesium-, or calcium salts of at the hydroxyl group of linear or branched, saturated or non-adjacently mono- to triunsaturated, cyclic or acyclic carboxylic acids with C_6- to C_{24}-esterified, monomeric lactic acid or the oligomers thereof, wherein the oligomerization degree of the lactic acid is preferably from 1.1 to 10, most preferably from 1.1 to 4, or alkyl-(poly)glucosides with an oligomerization degree of from 1.0 to 10, preferably from 1 to 3, and alkyl residues, which are branched or unbranched, saturated or non-adjacently mono- to triunsaturated, cyclic or acylic and have from 6 to 24 carbon atoms, or alkali-, alkaline earth-, mono-, di-, and trialkanol ammonium-, ammonium-, mono-, di-, trialkylammonium salts of alkylisethionates, which contain alkyl residues with 6 to 24 carbon atoms and are branched or unbranched, saturated or non-adjacently mono- to triunsaturated, or alkali-, alkaline earth-, mono-, di-, and trialkanol-ammonium-, ammonium-, mono-, di-, tri-alkylammonium salts of acylsarcosinates, which contain alkyl residues with 6 to 24 carbon atoms and are

branched or unbranched, saturated or non-adjacently mono- to tri-unsaturated, or protein condensates with C_6- to C_{24}-acyl residues, which are branched or unbranched, saturated or non-adjacently mono- to triunsaturated, or betaines having alkyl chains with 6 to 24 carbon atoms, which may be branched or linear, saturated or non-adjacently mono- to triunsaturated. Among betaines, those of the amido-amine type are preferred. Acylglutamates with 6 to 24 carbon atoms in the acyl chain, which can be linear or branched, saturated or non-adjacently mono- to triunsaturated, are also useful. In addition, particularly preferable detergent components for use in the blends of the present invention include acyllactylates and acylglutamates, and among the group of acyllactylate salts, the sodium salt of lauroyllactylate or of steraoyllactylate are especially suitable.

By the term 'mild' employed herein is meant that the compounds/compositions are not subject to labelling as irritating to the skin and eyes, e.g. according to directive 67-548-EEC, Hazardous Materials Ordinance.

By the term 'with poor-foaming characteristics' used herein is meant that the surfactants, when utilized as additional detergent components, do not fulfill two of the three requirements defined hereinbelow.

Foaming Behavior Criteria:

- Lamella thickness, in mm, immediately after foam formation,
- number of blisters per image surface (100fold magnification) immediately after foam formation, both determined by the foam microscopy, and
- initial foaming by hand test.

The oil component preferably comprises vegetable oils and ester oils, such as triglycerides of C_4- to C_{26}– fatty acids, branched, unbranched, mono- to triunsaturated, or paraffin oils, i.e. hydrocarbons with chain lengths of up to C_{16} (liquid; beyond this solid) or silicone oils. Typical examples of vegetable oils include sunflower-, rape-, soybean-, lavender-, aniseed-, rosemary-, spruce-, and larch oil, tea-tree (*melaleuca alternifolia*) oil, calendula oil, evening-primrose (*oenothera biennis*) oil, or cosmetic oils, such as avocado-, jojoba oil, or aloe vera.

Experiment

8 wt% of the surfactant under examination were dissolved in demineralized water. The resultant surfactant solution was stirred for 10 minutes using a vane stirrer at 1,500 rpm, whereby the solution was slightly heated from room temperature to approx. 35°C. After 10 minutes of stirring, the foam thus prepared was skimmed from the surface and was immediately examined microscopically (measurement of lamella thickness, in mm; determination of the number of foam blisters in the respective image frame).

Besides the quality of the foam produced by stirring, the initial foaming characteristics of a surfactant are also evaluated using cold, running tap water. For this purpose, 2 grams of surfactant are spread on the palm and are evenly rubbed in with running water. The foam quality is evaluated by four grades, namely 0 = no foaming, 1 = moderate foaming, 2 = good foaming, and 3 = excellent foaming.

Surfactants are rated poor-foaming, if they cannot fulfill at least two of the following three criteria, namely if the lamella thickness is less than or equal to 16 mm, or if the number of blisters in the image frame is less than or equal to 16, or if the initial foaming rating is 1 or less.

Surfactants are rated good-foaming, if they fulfill the three criteria insofar as the lamella thickness is
≥ 20 mm, the number of blisters in the image frame is
≥ 20, and the initial foaming rating is 3.

The blends of the invention are useful in the following formulations: skin and hair cleaning preparations, shampoos, baby shampoos, antidandruffs shampoos, aerosol shampoos, aerosol shower gels, washing-, shower-, and bathing gels, foam baths, oil foam baths, face wash creams, liquid handwash soaps, synthetic soaps (syndets), and combibar-type bar soaps. They can be employed alone or in combination with other detergents, and they are used in the formulations described herein in quantities of from 0.1 to 90 wt%, preferably 1 to 30 wt%, most preferably 1 to 15 wt%, based on the blend of the present invention.

Examples of other constituents, which can be combined with the blends of this invention in skin and hair cleaning formulations, include: alkylsarcosinates, fatty

alcohol ether sulfates, fatty alcohol sulfates, imidazolinium derivates, taurates, sulfobetaines, olefin sulfonates, ethercarboxylic acids and their salts, alkylaminoxides, ethoxylated fatty alcohols, ethoxylated fatty acids and their diesters, esters of ethoxylated polyols, fatty acid di- and -monoethanolamides, fatty acid mono-, -di- , and -triglycerides and their derivatives (-sulfates, -lactylates, -lactates, -citrates, -tartrates), ethoxylated castor oils and dehydrated castor oil derivatives, phospholipids, cationic surfactants and polymers, antidandruffs preparations, starch derivatives, glycerol esters and their ethoxylates, polyglycerol esters, sorbitan esters and their ethoxylates, silicone oils, silicone copolymers, panthenol, panthenolether, vitamin E and its derivatives, vitamin A and its derivatives, citric acid, lactic acid, hyaluronic acid, polyvinylpyrrolidone, polyacrylates, xanthane rubber, protein hydrolysates, acylglutamates. UVB filters (oil-soluble or water-soluble); examples of oil-soluble substances include: 3-benzylidene camphor and its derivatives, e.g. 344-(methylbenzylidene) camphor, 4-aminobenzoic acid derivatives, preferably 4-dimethyl-aminobenzoic acid (2-ethylhexyl)ester, (4-di-methylamino)-benzoic acid -amyl ester, esters of cinnamic acid, preferably 4-methoxycinnamic acid(2-ethylhexyl) ester, 4-methoxycinnamic acid isopentyl ester; esters of salicylic acid, preferably salicylic acid-(2-ethylhexyl) ester, salicylic acid-(4-isopropylbenzyl)ester, salicylic acid homomenthyl ester; derivatives of benzophenone, preferably 2-hydroxy-4-methoxybenzophenone, 2-hydroxy-4-methoxy-methylbenzophenone, 2,2'-dihydroxy-4-methoxy-benzophenone, esters of benzylmalonic acid. Examples of useful water-soluble substances include 2-phenylbenzimi-dazole-5-sulfonic acid and its salts, e.g. sodium-, potassium-, or triethanol ammonium salts, sulfonic acid derivatives of benzophenones and their salts; sulfonic acid derivatives of 3-benzylidene camphor and their salts.

The present invention will be further described with reference to the following examples.

Examples

Gemini surfactants employed herein:

Gemini Surfactant (General Formula)	Structure
A.A (A.I)	$R^1 = R^3 = C_{11}H_{23}/C_{13}H_{27}$, $R^2 = C_2H_4$, $X = Y = (C_2H_4O\text{-})_x(C_3H_6O\text{-})_ySO_3Na$, wherein x = 14, y = 0
B.A (B.I)	$R^1 = R^3 = C_{11}H_{23}/C_{13}H_{27}$, $R^2 = C_2H_4$, A = CH_2, M = Na
B.B (B.II)	$R^5 = R^6 = C_{12}H_{25}/C_{14}H_{29}$, X = C_2H_4, $Y^1 = CO_2Na$, Y^2 = -O-C(O)-C_2H_4-CO_2Na
B.C (B.II)	$R^5 = R^6 = C_{12}H_{25}/C_{14}H_{29}$, X = C_2H_4, $Y^1 = CO_2Na$, Y^2 = -O-C(O)-C_2H_4-CO_2Na
C.A (C.I)	$R^1 = C_{11}H_{23}$, B = C_2H_4, $R^3 = CH_2$, $R^4 = C_2H_4$, Y = COONa
D.A (D.I)	R, R^1 = -$C_{11}H_{23}$, R^2 = -S-, X = NZ, Z = -CH_3, Y, Y^1 = glucosyl residue
D.B (D.II)	R, R^1 = -$C_{11}H_{23}$, R^2 = single bond AO = -C(O)-, T, $T^1$1 = OM, M = Na
D.C (D.III)	R, $R^1 = C_{12}H_{24}$, R^8 = NYY1, Y = -CH_3, Y^1 = glucosyl residue

Methods of Test

In order to characterize the foams, 8 wt% of the surfac-tants or surfactant blends were dissolved in demineralized water. The resultant surfactant solutions were stirred for 10 minutes using a vane stirrer at 1,500 rpm, whereby the solutions were slightly heated from room temperature to approx. 35°C.

The procedure for making foam is illustrated by figures 1 to 3:

Fig. 1 Vane stirrer for making foam

Fig. 2 Test apparatus for making foam (dimensions in cm, wherein H means height of the nonfoamed solution)

Fig. 3 Condition after foaming (peripheral velocity of the vane stirrer = 5 m/s; S = foam; D = detergent solution).

After 10 minutes of stirring, the foam thus prepared was skimmed from the top and examined microscopically (immediately, after 2, 5, and 15 minutes). The test procedure was ever the same, thus allowing to evaluate the influence of the surfactant blends on the foaming behavior.

	(1)	(2)	(3)	(4)	(5)	(6)
	[%w/w]	[%w/w]	[%w/w]	[%w/w]	[%w/w]	[%w/w]
Phase A						
Surfactant	8.0	6.4	4.8	3.2	1.6	
Gemini surfactant A.A		1.6	3.2	4.8	6.4	8.0
Phase B						
Demin. water	92.0	92.0	92.0	92.0	92.0	92.0
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Preparation

- Weigh in phase A and melt at 80°C.
- Allow to cool, then add phase B.
- Stir for 10 minutes using a vane stirrer.
- Take product samples after 0, 2, 5, and 15 minutes.

The foam quality was evaluated by measuring the lamella thickness and determining the number of blisters found in the image frame (100fold magnification). It is known that the amount of cleaning fluid provided by the foam for wetting the skin and absorbing dirt increases as the lamella thickness increases, in other words, the thicker the foam lamella produced, the better the cleaning effect. The number of blisters per area is a measure of the fine porosity of the foam and can be referred to for characterizing the product touch on the skin.

The results of the foam evaluations with reference to the lamella thickness of the foam, expressed in mm (with 100fold magnification), have been compiled hereinbelow for blends of a gemini surfactant of the sodium diamide ethersulfate type and different mild surfactants with unsatisfactory foaming characteristics for skin and hair cleaning applications.

Example 1

Foam lamella thickness as a function of the mixing ratio of sodium lauroyl lactylate and gemini surfactant

	(1)	(2)	(3)	(4)	(5)	(6)
Time [min]	8.0 / 0.0	6.4 / 1.6	4.8 / 3.2	3.2 / 4.8	1.6 / 6.4	0.0 / 8.0
0	4	12	22	28	18	3
2	2	10	22	25	15	2
5	1	8	18	22	14	<1
15	<1	6	12	20	13	<1

Example 2

Number of foam blisters as a function of the mixing ratio of sodium lauryl lactylate and gemini surfactant

	(1)	(2)	(3)	(4)	(5)	(6)
Time [min]	8.0 / 0.0	6.4 / 1.6	4.8 / 3.2	3.2 / 4.8	1.6 / 6.4	0.0 / 8.0
0	4	12	22	28	18	3
2	2	10	22	25	15	2
5	1	8	18	22	14	<1
15	<1	6	12	20	13	<1

Example 3

Foam lamella thickness as a function of the mixing ratio of sodium cocoylisethionate (*Arlatone SCI*, ICI Surfactants, Everberg, Belgium) and gemini surfactant

	(1)	(2)	(3)	(4)	(5)	(6)
Time [min]	8.0 / 0.0	6.4 / 1.6	4.8 / 3.2	3.2 / 4.8	1.6 / 6.4	0.0 / 8.0
0	4	12	22	28	18	3
2	2	10	22	25	15	2
5	1	8	18	22	14	<1
15	<1	6	12	20	13	<1

Example 4

Number of foam blisters as a function of the mixing ratio of sodium cocoylisethionate (*Arlatone ACI*, ICI Surfactants, Everberg, Belgium) and gemini surfactant

	(1)	(2)	(3)	(4)	(5)	(6)
Time [min]	8.0 / 0.0	6.4 / 1.6	4.8 / 3.2	3.2 / 4.8	1.6 / 6.4	0.0 / 8.0
0	12	10	24	25	21	5
2	6	7	17	12	15	2
5	5	6	15	8	8	2
15	4	4	9	6	5	2

Example 5

Foam lamella thickness as a function of the mixing ratio of fatty alcohol polyglucosides (*Plantacare 1200*, Henkel, Düsseldorf) and gemini surfactant

	(1)	(2)	(3)	(4)	(5)	(6)
Time [min]	8.0 / 0.0	6.4 / 1.6	4.8 / 3.2	3.2 / 4.8	1.6 / 6.4	0.0 / 8.0
0	11	12	14	28	16	3
2	10	10	10	18	16	2
5	9	9	6	14	13	<1
15	5	5	5	10	10	<1

Example 6

Number of foam blisters as a function of the mixing ratio of fatty alcohol polyglucosides (*Plantacare 1200*, Henkel, Düsseldorf) and gemini surfactant

	(1)	(2)	(3)	(4)	(5)	(6)
Time [min]	8.0 / 0.0	6.4 / 1.6	4.8 / 3.2	3.2 / 4.8	1.6 / 6.4	0.0 / 8.0
0	32	31	17	28	19	5
2	28	24	11	18	12	2
5	20	18	10	14	12	2
15	13	13	9	10	9	2

Besides the foam quality produced by stirring, the initial foaming behavior of the surfactant blends in contact with cold, running tap water was evaluated as well. For this purpose, 2 grams of surfactant blend were spread on the palm and were evenly rubbed in with running water.

Example 7

Initial foaming of sodium diamide ethersulfates combined with different very mild, poor-foaming surfactants when rubbed in by hand in contact with cold, running water

	(1)	(2)	(3)	(4)	(5)	(6)
Surfactant	8.0 / 0.0	6.4 / 1.6	4.8 / 3.2	3.2 / 4.8	1.6 / 6.4	0.0 / 8.0
Sodium lauryllactylates	0	0	+++	+++	+	0
Sodium cocoylisethionates	+	+	+++	+++	++	0
Fatty alcohol polyglycosides	0	0	+	++	+	0

Surfactant	8.0 / 0.0	6.4 / 1.6	4.8 / 3.2	3.2 / 4.8	1.6 / 6.4	0.0 / 8.0
Sodium lauryllactylates and gemini B.A	0	0	+++	+++	+	0
Sodium cocoylisethionates and gemini B.B	+	+	+++	+++	++	0
Fatty alcohol polyglycosides und gemini B.C	0	0	+	++	+	0

Surfactant	8.0 / 0.0	6.4 / 1.6	4.8 / 3.2	3.2 / 4.8	1.6 / 6.4	0.0 / 8.0
Sodium lauryllactylates and gemini D.A	0	0	+++	+++	+	0
Sodium cocoylisethionates and gemini D.B	+	+	+++	+++	++	0
Fatty alcohol polyglycosides und gemini D.C	0	0	+	++	+	0

Foam rating legend: 0 = no foaming + = moderate foaming
++ = good foaming +++ = very good foaming

Example 8: **Examples of Formulations, Mild Shampoo**

Brand	CTFA / INCI	Model Form. *	Comparison *	Form. A *	Form. B *
Texapon NSO	Sodium laureth sulfate	40.00	40.00	40.00	40.00
Surfactant composition	Gemini A.I, sodium lauroyl lactylate (50 : 50)	8.0	0	4.00	8.00
Tego Betain F 50	Cocoamidopropyl betaine	0.0	8.00	0.00	0.00
D-Panthenol 75L	Panthenol	1.5	0.00	0.00	0.00
Octopyrox		3.0	0.00	0.00	0.00
Ucare Polymer JR-400	Polyquaternium-10	0.15	0.00	0.00	0.00
Antil 141 liq.	Propyleneglycol, PEG-55 propylene-glycol oleate	2.00	2.00	2.25	2.00
NaCl	Sodium chloride	1.0	1.00	1.25	1.00
Citric acid	Citric acid	0.75	0.00	0.00	0.00
Demin. water	Aqua	ad 100	ad 100	ad 100	ad 100

* as weight percent

Preparation: Mix at 40 °C, then thicken with Antil 141 liq. and NaCl.

In order to examine skin tolerance of the surfactant composition of the invention, the surfactant system of a typical shampoo formulation (alcohol ethersulfate + lenitive additive + thickening system) plus the surfactant composition of the invention were tested.

The aforesaid system was used in a repetitious patch test (Shelanski test) on 20 test persons:

A plastic chamber filled with the product under examination (2% in water) was attached for 24 hours with occlusion to a spot of the skin. This procedure was repeated nine times in three weeks while employing the same spot of the skin. After a two-week pause, the product in the plastic chamber was again attached for 24 hours to the very same spot of the skin as previously and to a non-exposed spot in order to examine the skin for potentially induced reaction. The examinations were made immediately after removal of the test chambers and after 24 h, 48 h, and 72 h.

The test results showed that the formulations A and B exhibit excellent skin tolerance. There were no signs of skin sensitisation. As to their skin-irritating potential, the products are not expected to cause harm.

When using the alcohol ethersulfate/betaine combination (comparative formulation), which is customary today, three test persons were found to have moderate skin irritation (redness, scaling).

Example 9 **Examples of Formulations, Mild Shower Gel**

Brand	**CTFA / INCI Nomenclature**	**wt%**
Tego Betain F 50	Cocoamidopropyl betaine	25.00
Surfactant composition	Gemini A.I, sodium lauroyl lactylate (50 : 50)	8.00
Arlatone SCI	Sodium cocoyl isothionate	2.00
Antil 141 liq.	Propyleneglycol, PEG-55 propyleneglycol oleate	q.s.
NaCl	Sodium chloride	q.s.
Demin. water	Water	ad. 100

Preparation: Mix at 50 to 60°C, adjust the pH value with citric acid if necessary, then thicken.

Example 10 **Examples of Formulations, Antimicrobacterial Cleaning Lotion**

Brand	CTFA /INCI Nomenclature	wt%
N-Cetyl-N,N,N-trimethylammoniumbromide	Cetrimonium bromide	2.00
Tego Betain F 50	Cocoamidopropyl betaine	20.00
DC 193 Surfactant	Dimethicone copolyol	1.50
Ucare Polymer JR 400	Polyquaternium-10	0.10
Surfactant composition	Gemini A.I, sodium lauroyl lactylate (50 : 50)	5.00
Euperlan PK 3000 AM	Glycol distearate, laureth-4, cocoamidopropyl betaine	3.00
Antil 141 liq.	Propyleneglycol, PEG-55 propyleneglycol oleate	q.s.
NaCl	Sodium chloride	q.s.
Demin. water	Water	ad. 100
pH after preparation		5.1

Preparation: Mix at 50 to 60°C, then thicken.